BOEM ENVIRONMENTAL STUDIES PROGRAM: Ongoing Study

Region: Pacific

Planning Area(s): All

Title: Developing and Applying a Vulnerability Index for Scaling the Possible Adverse Effects of Offshore Renewable Energy Projects on Seabirds on the Pacific OCS (PC-12-01)

BOEM Information Need(s) to be Addressed: BOEM will likely receive proposals to develop offshore renewable energy projects on the Pacific OCS. While data exist on the distribution of seabirds on the Pacific OCS, there is little information regarding the effects that offshore Pacific coast renewable energy development will have. The proposed study increases the understanding of the flight behavior of seabirds and provides a means to rank and assess the vulnerability of specific seabird species on the Pacific OCS based on the habits and activities of birds at sea. This information coupled with existing information on distribution and abundance can provide a means to assess and advise site selection for renewable energy project in a manner that minimizes adverse effects to seabirds.

Total Cost: $600,000 **Period of Performance:** FY 2012-2016

Conducting Organization: U.S. Geological Survey/BRD and U.S. Fish & Wildlife Service

Principal Investigators: Josh Adams and John Takekawa

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Description:

Background: One of the most pressing issues in marine and coastal research is determining the likely impact of offshore renewable energy projects on marine resources. The eastern Pacific near the coast of the western United States, and Hawaii and its surrounding waters, support many breeding seabirds and a variety of other bird species that migrate to or through these regions. A number of species of conservation concern occur in the Pacific Region, including several listed as threatened or endangered under the Endangered Species Act. The erection of offshore wind turbines or installation of wave hydrokinetic arrays may affect birds in several ways, including the risk of collision with the blades and other parts of the structure, and the displacement of individuals from otherwise suitable habitat. While data on the distribution and abundance of seabirds can advise the selection of locations for renewable energy projects, the habits and activities of birds at sea should be taken into account because vulnerability to effects will vary between species.

Understanding seabird flight characteristics is critical to evaluating the risk of collisions with blades and other parts of structures. While the design aspects of seabird flight have been investigated in detail, we still lack basic information about the height at which seabirds fly, as well as their flight directions with respect to prevailing wind directions. H. T. Harvey &

Associates possess data on the flying behavior of seabirds gathered over approximately 50 cruises during 20 years of at-sea surveys conducted along the west coast of the U.S., spanning the Pacific Ocean from pole to pole, and from the coast to Hawaii (1976-2006), with the major portion of data from the California Current (1985-2006). While some of these data have been analyzed, data on flight height as a function of wind speed and species of bird have not. Once the flight behavior data is analyzed, developing a sensitivity index for seabirds for the Pacific Region of BOEM will aid in evaluating the risks of offshore renewable energy development to the diversity of seabirds occupying this region.

Objectives: (1) Support the analysis of seabird flight behavior to inform the design, operations, and siting of offshore renewable energy projects; (2) develop a wind farm and wave array sensitivity index for seabirds on the Pacific OCS and off Hawaii; (3) apply the index to areas where offshore renewable energy development is most likely to occur; (4) summarize seabird vulnerability on digital maps with a grid size that matches offshore survey data; (5) develop levels of concerns that could act as a basis for selection of offshore renewable energy sites; (6) prepare a synthesis report that summarizes the analyses and findings; and (7) submit a modified version of the report to a peer-reviewed publication.

Methods: Generalized linear models will be used, including logistic regression, to test hypotheses regarding the flight height of seabird species and the potential effects of environmental variables (e.g., wind velocity, sea state). Indirect gradient analysis using non-metric multidimensional scaling and cluster analysis may aid in initially identifying patterns of behavior, and suggest options for constrained ordination techniques. Data on bird and wind velocities will be explored using statistical methods for circular distributions.

The index will be developed by ranking key vulnerability factors as Garthe and Hüppop (2004) did when scaling the possible effects of offshore renewable energy on seabirds in Europe. The factors they chose included flight maneuverability, flight altitude, percentage of time flying, nocturnal flight activity, disturbance by ship and helicopter traffic, flexibility in habitat use, biogeographical population size, adult survival rate, and threat and conservation status. These factors should be evaluated for relevance to evaluating seabirds in the Pacific Region and can be supplemented with others that would help refine the index (e.g., attraction to artificial lights; likelihood of resting on artificial structures rather than avoiding them).

Species evaluated in the index will include all seabirds expected to regularly occur on the Pacific OCS or off Hawaii. At a minimum, these will include species of waterfowl (7), loons (4), grebes (6), albatrosses (3), petrels (6), shearwaters (9), storm-petrels (8), tropicbirds (3), boobies (4), pelicans (1), cormorants (3), frigatebirds (3), phalaropes (2), gulls (11), terns (15), skuas (1), jaegers (3), and alcids (11).

The ranking of each factor for all species will be independently evaluated by a selected group of experts per factor. The experts would be chosen based on their experience with the species in the targeted regions or other areas where the species occur. The sensitivity index calculation would be similar to that identified by Garthe and Hüppop (2004), but may need to be adjusted if factors that were not considered in their index are incorporated. Once species-specific sensitivity indexes are developed, the scores will be integrated with existing distributional data to develop

vulnerability maps for areas of potential offshore renewable energy development. An index will be developed based on species density and sensitivity to offshore renewable energy development that will provide sensitivity values for surveyed grid cells at sea.

Current Status: USGS will perform the study through its OCS Offshore Biological Resource Allocation; the statement of work has been completed and project development has been initiated. Progress through March 2013 includes the following:

- Established collaboration and contracted with HT Harvey and Associates to initiate analyses of environmentally mediated seabird flight-height behaviors across multiple taxa.
- Established cooperative agreement with Moss Landing Marine Laboratories to initiate background literature reviews to concatenate existing, peer-reviewed, published information related to the ranging behaviors of seabirds at sea.
- Conducted extensive literature search to collect published data involving ranging behaviors at sea (i.e., activity budgets, time spent diving/in flight, dive depths, foraging range, etc.).
- Created working database of published seabird ranging parameters in order to evaluate patterns associated with taxa, morphology, and flight mode.

Preliminary results are as follows:

- Summarized data on the flight behavior of seabirds obtained on 131,354 sightings of 271 species tallied during 87 cruises that spanned much of the Pacific Basin 1976-2006, with effort concentrated in the California Current, Peru Current, tropical/subtropical waters (including Hawaii), waters around New Zealand, and the Southern Ocean (HT Harvey and Associates, *unpublished data*).
- Reviewed 356 published papers that reported information regarding at-sea ranging behaviors among >200 seabird species world-wide.

Continuing objectives for Fiscal Year 2013 are to:

- Complete flight-height analysis, obtain final report and study parameter estimates for model-predicted flight heights.
- Complete literature review and associated seabird behavior database.
- Initiate design of seabird species-specific vulnerability index based on appropriately ranked categorical parameters (e.g., demography, conservation status, cumulative risks at sea, population size, behavior at sea).

Final Report Due: December 2015

Publications Completed: None at this time.

Affiliated WWW sites: None at this time.

Revised Date: September 24, 2013